



S A N D I A

## LAB NEWS

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## Sandia-led center to advance understanding of new solar panel technology

Research will support perovskite technology performance, reliability, bankability

By **Mollie Rappe**

**T**he Department of Energy recently awarded \$14 million to two national labs to form a Sandia-led center to improve the understanding of perovskite-based photovoltaic technologies and determine the best tests to evaluate the new solar panels' lifetimes.

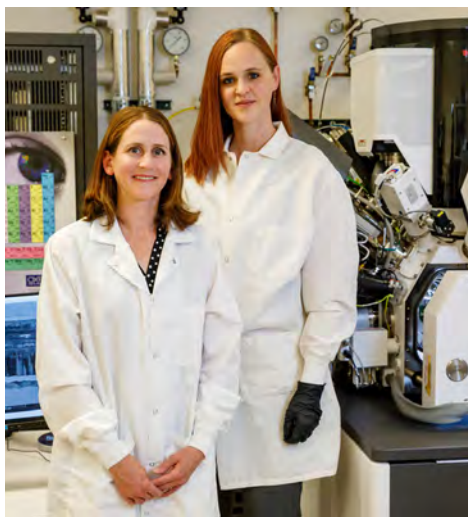
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**IN THE LIMELIGHT** — Joshua Stein, a Sandia systems engineer and director of the new Perovskite Photovoltaic Accelerator for Commercializing Technologies Center, left, prepares a solar module for testing at the Labs' Photovoltaic Systems Evaluation Laboratory, which will be used to support the commercialization of U.S. perovskite-based photovoltaic technologies. Charles Robinson, a technologist, stands beside him.

Photo by Randy Montoya

## The hidden culprit killing lithium-metal batteries from the inside



**IMAGING INNOVATORS** — Scientists Katie Harrison, left, and Katie Jungjohann have pioneered a new way to look inside batteries to learn how and why they fail.

Photo by Bret Latter

First-of-their-kind snapshots reveal byproduct crippling powerful, experimental cells

By **Troy Rummler**

**F**or decades, scientists have tried to make reliable lithium-metal batteries. These high-performance storage cells hold 50% more energy than their prolific, lithium-ion cousins, but higher failure rates and safety problems like fires and explosions have crippled commercialization

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## STEM IN THE SUN

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## LABNEWS Notes

**EDITOR'S NOTE:** We've stopped printing the *Lab News*, but will continue to publish every two weeks. We want you to remain in our community of readers, so please send your comments and suggestions for stories or for improving the paper. *Lab News* welcomes guest columnists who wish to tell their own "Sandia story" or offer their observations on life at the Labs or on science and technology in the news. If you have a column (500-800 words) or an idea to submit, contact *Lab News* editor Katherine Beherec at kgbeher@sandia.gov.

# Black Leadership Committee engages middle and high school STEM students



**SUMMER OUTREACH** — Tineca Quintana and Joshua James distributed kits to families participating in education outreach this summer. Sandia's Black Leadership Committee hosted the virtual Hands-On Minds-On Technologies Summer Youth Program on Saturdays in June for 50 middle and high school students. The program included volunteer and mentorship opportunities for employees and students in fun, hands-on science and engineering activities. Participants learned about the electromagnetic spectrum, chemistry, a circuit playground and a variety of STEM careers.

Photo by Cheryl Garcia



## Mileposts



John Matthews

30



Paul Crozier

20



Russell Hooper

20



Yvonne Petrova

20



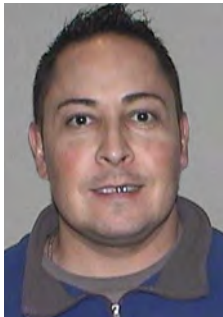
David Logsted

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## JOIN THE CONVERSATION

Sandia Labs has official social media accounts on several online communities to engage in conversations about our work, update followers about the latest Labs news, share opportunities, and support the open government principles of transparency, participation and collaboration.

Visit us on your favorite networks and join the conversation.



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Giphy  
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# ANGLE members donate nearly a thousand pounds of food and supplies to local animal organizations



**DOG DAYS** — Caroline Winters sorts pet food during the recent heat wave following ANGLE's Homeward Bound pet drive. Employees dropped off more than 800 pounds of dry dog food, 130 pounds of wet cat food, and several boxes of dog toys, blankets, collars and leashes at Sandia Laboratory Federal Credit Union locations in New Mexico to help homeless pets that are waiting for their forever homes. Lap Dog Rescue New Mexico, Animal Humane New Mexico and June's Senior Cats were among the organizations that received donations.

Photo by Katrina Wagner



# Renewable energy, mentoring leader receives Women in Technology Award

*Sandra Begay recognized for her work and advocacy*



**TRAILBLAZER** — Researcher Sandra Begay recently received a Women in Technology Award from the New Mexico Technology Council.

Photo by Lonnie Anderson

By **Manette Newbold Fisher**

For many achievements in research, mentorship and community impact, the **New Mexico Technology Council** celebrated researcher Sandra Begay with a **Women in Technology Award**.

“I’m very honored to receive the Women in Technology award in my home state, and I appreciate the acknowledgment of my Sandia tribal energy work,” Sandra said.

According to the New Mexico Technology Council website, the annual awards recognize women who represent a variety of STEM industries and show exemplary commitment to mentorship and community impact. Sandra was selected as one of six Women in Technology honorees out of a pool of 49 nominations and 24 applications. An

additional Emerging Leader Award was presented by the council for the first time this year.

## Work with U.S. tribes, Indigenous interns drives engineer's research

Sandra has been a Sandia engineer working primarily on renewable energy development for 29 years, many of them dedicated to positively impacting U.S. tribes. Nearly two decades ago, Sandra began providing technical assistance to the Navajo Tribal Utility Authority, which received federal funding to begin a program focused on a photovoltaic solar electric system for residential customers who were not connected to the electrical grid. With federal sponsorship, she was able to provide technical assistance to more than 15 U.S. tribes for 16 years.

“Sandra Begay’s impact at Sandia, in New Mexico and throughout the nation is incredible,” said Senior Manager of Business Development Mary Monson. “When our team discussed who to nominate for the Women in Technology Award, Sandra stood out because she uses research and technology to change lives. She is a trailblazer in renewable energy development in addition to being a leader to students and young professionals working to build careers in science.”

Sandra, a member of the Navajo Nation, mentored Indigenous Sandia interns through a **program she created** that was sponsored by Sandia and the Department of Energy’s Office of Indian Energy.

“Pride is an understatement when reflecting on my time with my former interns,” she said. “I keep track of their accomplishments and celebrate all

of their endeavors. I started my tribal energy work with one Native woman intern and grew the program to mentor more than 40 interns since 2002.”

As one of only 13,000 U.S. Native American women engineers (0.007% of all engineers), Sandra understands the unique challenges Indigenous STEM students face and has recommended systemic change in education programs to help the American Indian and Alaska Native communities.

As part of the Sandia internship program, students spent summers working on Indian energy projects and research. Each year, [field visits to tribal lands](#) enabled the interns to learn about and help solve real-world technical problems.

“I’m happy that a few interns were hired by Sandia,” she said. “All are leaders in renewable energy academic studies, in nonprofit work and in tribal projects. I feel that I provided a stepping-stone of a real tribal project, in real time, which complemented the interns’ academic studies.”

## Mentors, early career work led Sandra to where she is today

On paper, Sandra’s accomplishments and [awards](#) fill multiple pages, but when asked what stands out to her as a couple of specific highlights, she recognizes the mentors who helped her grow and early career work as the base of all she is recognized for now.

“I am grateful to all of my mentors who helped me create a vision beyond my engineering tasks,” she said. “I am proud of my early technical assistance work with the Navajo Nation’s residential solar program and the tribal strategic energy plans I facilitated all across the country, including Alaska.”

Prior to working at Sandia, Sandra was employed at Lawrence Livermore National Laboratory and Los Alamos National Laboratory. Beyond her technical work, she holds leadership roles on boards and committees at the University of New Mexico and has served as a member of the National Academies of Science, the National Academy of Engineering, the National Science Foundation, the American Society

of Civil Engineers, the American Indian Science and Engineering Society and the Presbyterian Health System Board.

Women in Technology nominations and applicants were evaluated on four criteria: impact to their profession, volunteerism, mentorship and entrepreneurialism, according to the council. The awards ceremony was [streamed virtually](#) on June 10.

“Sandia serves as a New Mexico Technology Council community partner, and we appreciate being part of an organization that honors women in STEM fields,” said David Kistin, manager of business development and New Mexico Technology Council vice chair. “We’re proud that Sandra Begay received one of the 2021 awards. Her work shows what can happen when the Labs connect innovative technology and researchers with community partners.”

In the future, Sandra looks forward to seeing what young engineers accomplish.

“I look forward to other Native young people taking a leadership position,” she said. “They can address the challenges ahead. I love what I do, but I look forward to future adventures.” [@](#)

## Perovskite center

*CONTINUED FROM PAGE 1*

The efficiency of perovskite-based solar cells has reached 25%, approaching the levels of common crystalline silicon-based solar cells. Perovskite solar cells use common starting materials and can be produced at a much lower temperature using more standard methods, said Joshua Stein, a Sandia systems engineer and director of the new center. This means perovskite-based solar panels have the potential to be significantly cheaper and less energy-intensive to manufacture compared with silicon solar cells.

However, perovskite-based photovoltaic technologies still have several challenges to overcome before they can compete against conventional solar panels. The Perovskite Photovoltaic Accelerator for Commercializing Technologies Center offers solutions to these challenges.

“If we want to meet the U.S.’s goals of increasing the amount of power from

renewable energy, we’re going to need a lot more manufacturing capacity,” Joshua said. “Perovskite photovoltaic technologies may provide a pathway to low-cost manufacturing, but there is still much that is unknown about this technology, especially in terms of outdoor performance and reliability. The center will field-test and monitor this technology using a common set of testing protocols so that every device can be fairly compared.”

The center, which also includes [National Renewable Energy Laboratory](#) and [Black and Veatch](#), will serve as a neutral evaluator of technologies and companies and will have three primary focuses to help companies quantify and characterize risks related to performance, reliability and bankability.

## Performance: Developing a common rubric

Perovskite solar cells can be made of a wide variety of chemicals and using numerous methods. This variability is a strength but can also make it challenging

to compare the performance characteristics, such as energy efficiencies at different light conditions or operating temperatures. A solar cell is a small device that captures sunlight and converts it into electricity. A solar module is made up of multiple solar cells connected and integrated together.

“Right now, it’s like the Wild West,” said Joshua, who has led the photovoltaic performance modeling collaborative for the past decade. “There are no established standards or test protocols for assessing perovskite solar modules. We would like to craft a clear set of test protocols that have been validated and vetted by the industry to create a rubric or set of goalposts, so that companies that are getting into perovskite solar technologies know what they need to do.”

Within the first year, the team wants to test at least 30 perovskite modules outside at Sandia’s [Photovoltaic Systems Evaluation Laboratory](#) and NREL. Eventually they hope to expand performance testing to at least 50 kilowatts of perovskite-based photovoltaic modules and full systems.



## Reliability: Withstanding the tests of time

The center also is focused on determining the reliability of perovskite solar modules, or how they perform in the field over a long time and how they begin to degrade, said **Laura Schelhas**, a research scientist and group manager at NREL and deputy director of the center.

“NREL’s role in leading the reliability focus area is to provide a lot of the scientific basis behind understanding reliability in perovskite-based solar modules,” said Schelhas. “This means looking at the degradation of these materials in contrast to traditional solar cell materials, what is causing this degradation, how to test for it and how to accelerate it in a meaningful way for the tests.”

Researchers use accelerated testing protocols — like exposing modules to high humidity or intense ultraviolet light, or rapidly switching between hot daytime and cool nighttime temperatures— to “kind of look into the future and predict the long-term reliability of these panels in the real world without having to wait 30 years,” Schelhas said.

The researchers will compare the results from the lab-based accelerated tests to real-world field-based tests to ensure that their reliability tests are accurate.

Another goal for the center is to show that tests conducted at NREL and CFV Labs, an Albuquerque-based commercial photovoltaic testing lab that is part of the center, produce very similar results from identical solar modules. Joshua added, “If you’re going to develop standards, you have to make sure that commercial companies can run those standard tests.”

## Bankability: Ensuring a safe investment

“Bankability is providing independent assessments of the technology and company so that banks and other investors can trust that the technology will work and last,” said Ralph Romero, senior


managing director of Black and Veatch Management Consulting’s Independent Assessment of Novel Technologies practice, and leader of the center’s bankability area.

“Support from this center will allow technology developers to overcome the challenges that are hindering the development of the technology today,” Romero said. “Specifically, I see this center as a way for technology developers, who generally don’t have a strong commercial background, to receive invaluable guidance on what they need to achieve to be commercially successful.”

Within two years, the goal is to conduct bankability roadmaps for at least two perovskite-based photovoltaic companies to help them plot their paths to commercialization. By the fourth year, they plan to conduct complete bankability assessments of at least two companies.

A complete bankability assessment takes about six months and looks at the design of the new product, its performance and reliability, the manufacturing process, the installation and maintenance process for the product and the company overall, Romero added.

“The DOE has made this investment to create an independent and neutral assessment center,” Schelhas said. “The partnership between Sandia and NREL is really powerful. At NREL, we have a lot of experience with perovskite technology, and Sandia has years of experience with field testing. Together we can provide that independent assessment of the technology. Hopefully, this will lead to U.S. manufacturing of perovskite solar panels.”

Other institutions involved in the center include **Los Alamos National Laboratory**, **CFV Labs** and the **Electric Power Research Institute**. 



MISSION  
FORWARD

This is  
why I got  
vaccinated.

They're safe. They keep you safe. They keep others safe. [coronavirus.sandia.gov](https://coronavirus.sandia.gov)



# California campus breaks ground for new cafeteria



**THROWING DIRT** — Sandia leadership, Facilities personnel, and contractors prepare to break ground for a new cafeteria at the Labs' Livermore site on June 15.

Photo by Dino Vournas

by **Paul Rhien**

In an informal event under the Chinese pistache trees located west of building 929, Sandia leadership, Facilities personnel, and architecture and construction contractors gathered on June 15 to break ground for the new cafeteria at Sandia's Livermore site. Construction on the 2,400-square-foot food-service facility will begin as soon as possible and is expected to be completed and open for operation by early summer 2022.

"This is a really big step for the California site," said Director of California Site Operations Pam McKeever, noting that the new cafeteria will be an important upgrade from the current grab-and-go offerings in the 915 café.



**SITE IMPROVEMENTS** — Director of California Site Operations Pam McKeever, left, celebrates the commencement of construction for a new cafeteria at the Livermore site, as Associate Labs Directors Harold Yeldell and Andy McIlroy and Labs Director James Peery look on.

Photo by Dino Vournas





**INNOVATIVE DESIGN** — Architectural rendering of the 2,400-square-foot California Cafeteria.  
Photo Courtesy of Shah Kawasaki Architects



**UPGRADING FOOD SERVICE** — Special guests and visitors visit following the cafeteria groundbreaking event on June 15.  
Photo by Dino Vournas

“People have been asking for better food-service options on-site for a long time, and we’re really pleased to be making this move to better accommodate this need,” Pam said.

Working with architecture and engineering contractors, Facilities has taken an innovative design approach for the cafeteria to meet NNSA cost requirements, according to Pam. The metal building will include prefabricated construction with customizations, including a 500-square-foot external, standalone kitchen. Indoor dining space may be complemented by optional outdoor covered seating if funding allows.


The new cafeteria will also be positioned in the General Access Area, creating opportunities for dining with invited guests from the public.

“It was a long journey and a multi-year effort to get to where we are today,” Pam said, explaining how a multi-functional operations team has used the [Integrated Service Delivery model](#) in completing feasibility studies, cost allowability analysis, and even making a change to Sandia’s prime contract in order to move the project forward.

Pam thanked Laboratories Director James Peery for his support since he took the helm at Sandia last year. James was visiting from New Mexico for a series of meetings and was on hand for the groundbreaking.

“Since James’s first visit to the California site as labs director, he has supported upgrading our cafeteria, and we’ve been really grateful for his backing,” Pam said.

Pam and James were joined by Associate Labs Directors Harold Yeldell and Andy McIlroy to lead the ceremonial turning of soil at the site of the new facility.

Contract vendor operations will be co-managed by Facilities and Employee & Health Benefits organizations. More details of food-service and menu options will be determined in the coming months. 



## Lithium batteries

CONTINUED FROM PAGE 1

efforts. Researchers have hypothesized why the devices fail, but direct evidence has been sparse.

Now, the first nanoscale images ever taken inside intact, lithium-metal coin batteries (also called button cells or watch batteries) challenge prevailing theories and could help make future high-performance batteries, such as for electric vehicles, safer, more powerful and longer lasting.

“We’re learning that we should be using separator materials tuned for lithium metal,” said battery scientist Katie Harrison, who leads Sandia’s team for improving the performance of lithium-metal batteries.

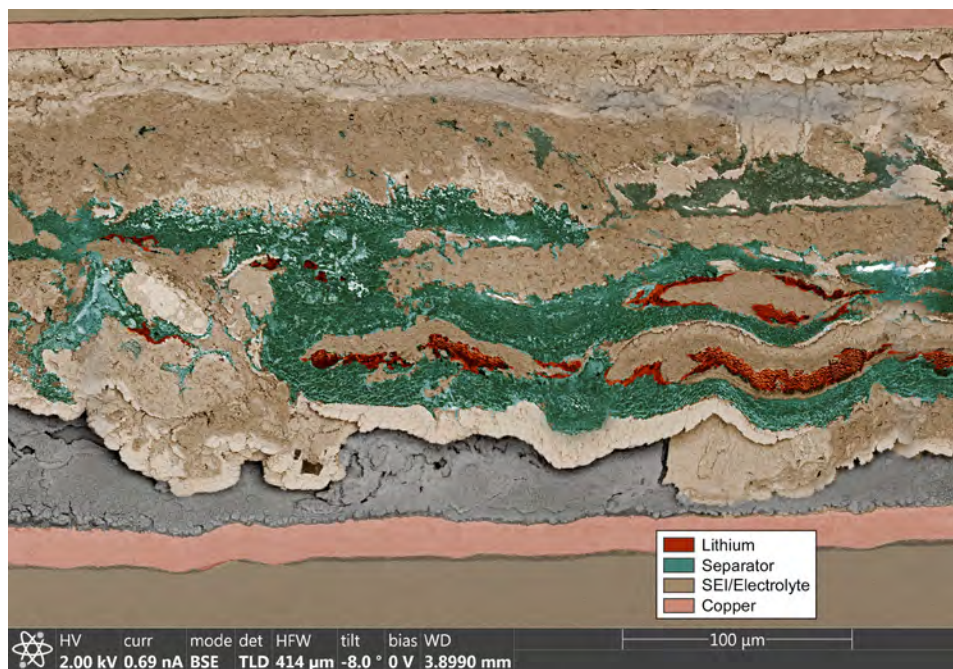
Sandia scientists, in collaboration with Thermo Fisher Scientific Inc., the University of Oregon and Lawrence Berkeley National Laboratory, published the images recently in [ACS Energy Letters](#). The research was funded by Sandia’s [Laboratory Directed Research and Development](#) program and the Department of Energy.

### Internal byproduct builds up, kills batteries

The team repeatedly charged and discharged lithium coin cells with the same high-intensity electric current that electric vehicles need to charge. Some cells went through a few cycles, while others went through more than a hundred cycles. Then, the cells were shipped to Thermo Fisher Scientific in Hillsboro, Oregon, for analysis.

When the team reviewed images of the batteries’ insides, they expected to find needle-shaped deposits of lithium spanning the battery. Most battery researchers think that a lithium spike forms after repetitive cycling and that it punches through a plastic separator between the anode and the cathode, forming a bridge that causes a short. But lithium is a soft metal, so scientists have not understood how it could get through the separator.

Katie’s team found a surprising second culprit: a hard buildup formed as a byproduct of the battery’s internal chemical reactions. Every time the battery recharged, the



**BATTERY BREAKTHROUGH** — In this new, false-color image of a lithium-metal test battery produced by Sandia, high-rate charging and recharging red lithium metal greatly distorts the green separator, creating tan reaction byproducts, to the surprise of scientists. **Image by Katie Jungjohann**

byproduct, called solid electrolyte interphase, grew. Capping the lithium, it tore holes in the separator, creating openings for metal deposits to spread and form a short. Together, the lithium deposits and the byproduct were much more destructive than previously believed, acting less like a needle and more like a snowplow.

“The separator is completely shredded,” Katie said, adding that this mechanism has only been observed under fast charging rates needed for electric vehicle technologies, but not slower charging rates.

As Sandia scientists think about how to modify separator materials, Katie says that further research also will be needed to reduce the formation of byproducts.

### Scientists pair lasers with cryogenics to take ‘cool’ images

Determining cause-of-death for a coin battery is surprisingly difficult. The trouble comes from its stainless-steel casing. The metal shell limits what diagnostics, like X-rays, can see from the outside, while removing parts of the cell for analysis rips apart the battery’s layers and distorts whatever evidence might be inside.

“We have different tools that can study different components of a battery, but really we haven’t had a tool that can

resolve everything in one image,” said Katie Jungjohann, a Sandia nanoscale imaging scientist at the [Center for Integrated Technologies](#). The center is a user facility jointly operated by Sandia and Los Alamos national laboratories.

She and her collaborators used a microscope that has a laser to mill through a battery’s outer casing. They paired it with a sample holder that keeps the cell’s liquid electrolyte frozen at temperatures between minus 148 and minus 184 degrees Fahrenheit (minus 100 and minus 120 degrees Celsius, respectively). The laser creates an opening just large enough for a narrow electron beam to enter and bounce back onto a detector, delivering a high-resolution image of the battery’s internal cross section with enough detail to distinguish the different materials.

The original demonstration instrument, which was the only such tool in the United States at the time, was built and still resides at a Thermo Fisher Scientific laboratory in Oregon. An updated duplicate now resides at Sandia. The tool will be used broadly across Sandia to help solve many materials and failure-analysis problems.

“This is what battery researchers have always wanted to see,” Katie Jungjohann said.

# July brings a wealth of financial wellness information to Sandia

By **Shelley Kleinschmidt**

In July, Sandia Human Resources will present Financial Wellness Month, a series of virtual presentations that cover a wide variety of topics relevant to members of the workforce of all generations and career stages.

Financial Wellness Month focuses on the importance of financial health as a critical aspect for the overall health and well-being of members of the workforce.

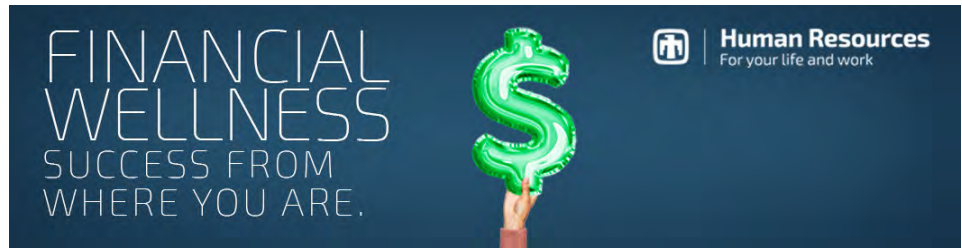
“We know that financial stressors can tie to overall mental health and even more so this year with the COVID-19 pandemic and its ongoing financial impact that has affected so many,” said Senior Manager Mary Romero Hart. “Financial health is key to people’s overall wellbeing and ability to thrive both at home and at work, which is our goal for Sandians.”

The vision of Financial Wellness Month is that every Sandian benefits from the monthlong event by learning how to reduce financial stress, improve financial literacy and explore financial topics they may not have otherwise researched.

The 2021 event will feature **29 presentations** with financial information, opportunities and discounts for all Sandians. External presenters include Fidelity, Prudential, Sandia Laboratory Federal Credit Union, the Social Security Administration and Corestream, the Labs’ partner in administering the Sandia Extras Voluntary Benefits program.

“We are excited to be providing diverse topics applicable to Sandians at varying career levels with multigenerational perspectives and unique individual needs,” Mary said. “They include everything from 401k planning, buying a first home, insurance, saving for emergencies, preparing for retirement, paying off student loans, saving for college and even navigating market volatility.”

Throughout July, members of the workforce can explore presentations on diverse topics such as “money musts,” retirement planning and Social Security, student debt, strategic money moves by age range, setting financial goals, managing financial



**\$UCCE\$\$ IS IN YOUR HANDS** — The motto for this year’s Financial Wellness campaign is “Success from where you are.”

stress, paid leave benefits, college funding, estate planning and many more.

Employee Health Services also will offer presentations aligned with Financial Wellness Month, including two Nutri Chats on “Affordable and delicious summertime favorite foods” and the “Show me the money” HRA Earnings Session.

All Financial Wellness Month events are free to members of the workforce. Sandia and, in some cases, the external presenters will require enrollment through their

websites for each presentation.

Financial Wellness Month participants will be awarded 1,000 points in their Virgin Pulse membership account by August 15. Participants in the Employee Health Services events will receive an additional 500 Virgin Pulse points for each attended event, as administered by instructors.


More information on schedules, how to enroll for presentations and other financial resources is available on the [HR Solutions Financial Wellness page](#).



# STEM in the Sun brings science to students in summer programs across Albuquerque

Story by **Katrina Wagner**  
Photos by **Randy Montoya**

**S**andia is working with multiple City of Albuquerque community centers in June and July to offer STEM in the Sun to elementary and middle school age students attending summer programs. Volunteers lead the kids in STEM activities like making lava lamps and three bean salad, Math Bingo, Gluep and learning about optical illusion and surface tension with pennies, a dropper and ultraviolet beads. Sandia volunteers interact with the kids and offer additional education.

Community Relations Specialist Cheryl Garcia organized STEM in the Sun. “The children are so energized with these STEM activities, especially now that they’re able to do activities in person. I think the kids missed the interaction with each other and are having so much fun reconnecting this summer,” said Cheryl. 



Students learn about surface tension by competing to see who can get the most drops of water on a penny.



Students experiment with solids and liquids as they make Gluep (slime) using glue, borax and food coloring. Students are given ideas for science activities they can do at home.



Creating a lava lamp with vegetable oil, food coloring, water and Alka Seltzer tabs in the sun is fun! Students take home their experiments at the end of the program.



The Spaghetti Marshmallow building challenge requires students to practice a design mindset and learn basic engineering principles.



Making your very own lava lamp is fun! Students learn about water solubility in this fun chemistry experiment.